

Specification for High Frequency Ionosonde System

Description

The specification is for a frequency agile phase coherent ionosonde system to be delivered by the contractor to the Naval Research Laboratory (NRL), Washington, DC. The system shall be capable of generating and receiving arbitrary waveforms over the frequency range of 500 KHz to 25 MHz and be capable of recording and displaying the received data as Range versus Frequency. The exciter system and receiver system shall be capable of use in a bistatic configuration. The system shall include waveform generation, high power amplification, receive antennae, receiver/digitizer, control/processing and data storage. Documentation for system operation and all high level software source code necessary for the operation and customization of the system shall be supplied.

High Frequency Ionosonde System - CLIN 0001

1. Exciter

The exciter shall consist of at least two channels capable of arbitrary waveform generation with up to 100 KHz of instantaneous bandwidth from user input baseband waveforms with a carrier frequency from 500 KHz to 25MHz. Documentation of data formats and protocols shall be provided such that waveforms can be created in MATLAB or other computer programs.

- RF frequency 500KHz to 25MHz
- Frequency resolution < 1Hz
- waveform repetition rate 10 - 200 pps
- waveform bandwidth 10 - 100 KHz
- arbitrary modulation $\geq 16K$ chips
- output power 0 dBm nominal
- max duty cycle 100%
- harmonic output (in band) < -60 dBc
- harmonic output (out of band) < -80 dBc
- spurious output < -80 dBc
- two arbitrary exciter channels need to be capable of phase coherent operation at ± 5 degrees.

2. Power Amplifier

The system shall provide a single channel pulsed output amplifier. Amplifier shall be a linear design such as class A-B.

- frequency 500 KHz to 25 MHz
- peak power > 3KW at 1dB compression
- max duty cycle $\geq 2\%$
- gain flatness ± 1.5 dB at 10dB below max power (met without additional calibration)
- Harmonics -30 dBc in band, -60 dBc out of band

3. Receiver

The receiver system shall consist of a minimum of 8 independent channels with appropriate front end analog amplification and filtering with instantaneous bandwidth of at least 100KHz with a carrier frequency from 500 KHz to 25 MHz. The system will have the capability to collect and apply calibration data.

- sampling rate up to at least 200KHz
- dynamic range (noise) > 100 dB at 25 KHz bandwidth
- dynamic range (spur free) > 80 dB
- third order intercept 30 dBm at 10MHz
- minimum detectable signal < -100 dBm at 25 KHz bandwidth
- attenuation ≥ 32 dB in 1 dB steps
- phase coherence < $\pm 5^\circ$ channel to channel

4. Receive Antennae

- The system shall be supplied with a minimum of 4 cross polarized antennae which cover the frequency range of 500 KHz to 25 MHz. Each antenna shall cover the entire 500 kHz to 25MHz resulting in 8 receive channels.
- The Receive Antennae shall be transportable.
- The receive system must operate in a 10 knot wind without degradation of sideband phase noise specification.
- The receive system must withstand a 0dBm input. This may be achieved through system attenuation. Maximum wind without damage shall be in excess of 30 knots.

5. Control and Data collection

The system shall be software controlled using a standard x86 based computer. Control and processing software shall be in C language. The system shall be capable of remote operation assuming the presence of a

suitable network connection. The data collection shall be greater than 1 Msample/sec at 16 bits complex baseband.

6. System Coherence and Timing

The system shall be capable of operating in a monostatic or bistatic configuration assuming the presence of a GPS signal. The system clock shall be at least 80MHz.

- frequency accuracy $\pm 1 \times 10^{-8}$
- SSB phase noise
 - 110 dBc/Hz at 10Hz
 - 130 dBc/Hz at 100Hz
 - 145 dBc/Hz at 1 KHz
 - 150 dBc/Hz at 10 KHz
 - 150 dBc/Hz at 50 KHz

7. Enclosures

The system shall be mounted in a standard 19 inch rack with the ability to be separated for bistatic operation. All enclosures that require power shall operate using standard 120VAC at 60Hz.

Training – CLIN 0002

The contractor shall provide training for up to 6 people. Training will be conducted at the Naval Research Laboratory for a minimum of 3 full days at time of acceptance of CLIN 0001.

Testing – CLIN 0003

The contractor shall deliver the High Frequency Ionosonde System to the Naval Research Laboratory, Washington, DC. The High Frequency Ionosonde System shall be delivered no later than six (6) months after contract award. The contractor shall set-up the system in the laboratory with dummy load antenna connections. The contractor shall verify all requested specifications will be verified, where applicable, using standard (Agilent etc.) test equipment.

Documentation – CLIN 0004

The contractor shall provide documentation for system operation and all high level software source codes necessary for the operation and customization of the system.

Warranty - CLIN 0005

The manufacturer warrants the product to be free from defects in material and workmanship for a period of twelve (12) months from date of acceptance. Items returned to the manufacturer for service will include written correspondence describing the failure with freight prepaid to a CONUS address provided by the manufacturer. The manufacturer will repair or replace the product at their expense and will pay freight charges back to the customer.